PEST TECHNOLOGY
Pest Control and Pesticides

Technical Editor - A. K. Palmer, B.Sc.

Vol. 2. No. 12 September 1960

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Published monthly in Great Britain by Rhodes Industrial Services Ltd., 36 Clarges Street, London, W.1. Telephone: GROsvenor 7323

Printed for the Publishers by Goddards & Cawley Ltd., Ropery Street, Hull, Yorks.

Leader

THIS ISSUE marks the end of our second volume and looking back through our past editorials we find that the topic of safety has cropped up time and again. Usually our editorials on this subject have been prompted by some illogical, ill-advised and exaggerated remark to the effect that pesticides cause cancer, leukaemia, etc. and will affect the genetic constitution of man to such an extent that future generations will be composed of misshapen morons. Other nonsensical statements have claimed that our wildlife population will be decimated and land surfaces turned into a dust bowl.

In the face of such mud slinging the industry and those of us realising the invaluable part played by pesticides in maintaining and increasing the standard of living have been left with but one course of action and that is to give the greatest possible publicity to the benefits afforded by pest control chemicals and to the tremendous efforts made by manufacturers, users and advisory officers to ensure the safe use of these chemicals. However whilst presenting pesticides in this way we must not be tempted to forget that behind the mass of misrepresentation there may be a small grain of truth, albeit magnified out of all proportion. This evidence no matter how small, must be selected from the vast volume of fearful conjecture, and its true value assessed. In other words the Industry must continually strive to improve its efforts to ensure the safe use of pesticides.

This point of view has been put in stronger terms in the editorial columns of *Agricultural Chemicals* **15** (8) following an incident in which 34 pilots and mixers had to undergo treatment as a result of failing to observe normal precautions while applying highly toxic phosphate pesticides. Following a brief account which gave just appreciation to the efforts, made by the majority of firms concerned with the manufacture of agricultural chemicals in the U.S., to attain a safety record that would stand comparison with any other industry turning out a similar end product, the editorial continued:-

"We occasionally have the feeling that some firms in the insecticide business are willing to let their responsibility end with the sale of the product. As we see it their responsibility is not discharged until they follow through with an educational programme which no user of the product can miss, hammering away month after month at the necessity for observing adequate precautions."

This comment was made to American pesticide manufacturers but is it worth bearing in mind by pesticide manufacturers the world over.

REVERTING ONCE MORE to the problem of safety we have stated that one of the difficulties manufacturers have to face is to select constructive criticism from a hysterical rambling. To be fair, we will now quote from correspondence with Mr. Ian Waddington, Chief Chemist, Tweed Purification Board, an example of, what we consider to be, carefully considered criticism.

Continued on page 262

DIAZINON FOR THE CONTROL OF PUBLIC HEALTH PESTS

by J. B. MARCHANT, B.sc.

THE DISCOVERY OF DDT, the first of the modern synthetic organic insecticides, in the research laboratories of J. R. Geigy S.A., in 1939, marked the beginning of a new era in insect control and the use of DDT and other synthetic insecticides such as BHC and dieldrin has enabled successful control measures to be taken against insect pests on a scale never previously contemplated. For the first time the complete eradication of some insect-borne diseases became a possibility and vast reductions of disease were rapidly accomplished.

Since the first report in 1947 of the development of a strain of insects resistant to DDT, the problems posed by the development and spread of insect resistance to modern synthetic insecticides have increasingly occupied the attention of public health authorities. Whatever long term solution may emerge from fundamental studies, the day-to-day need is to prevent loss of ground; the problem of resistance is already a serious one and there is grave danger that a worsening of the situation could undo the great achievements of the last 20 years in reducing the occurrence of insect-borne disease.

Although no long term solution to the problem can be envisaged at present, there are precautions which can be taken to reduce the likelihood of resistance arising, and to prevent its spread. The use of alternative insecticides in rotation is an obvious answer but the field of choice is limited; in general modern synthetic organic insecticides fall into three groups from the point of view of resistance. The first group contains DDT and related compounds such as methoxychlor, the second group BHC, dieldrin, endrin, chlordane etc., while the third group comprises the organophosphorus insecticides (including parathion, malathion, trichlorphon (Dipterex), and diazinon). Resistance to any one of the insecticides in a group will normally be quickly followed by resistance to all the others in the same group—thus in any given case of resistance the choice of alternative products is effectively limited. Within this basic situation there are other factors of importance; there is, for example, evidence that not all insecticides induce resistance at the same rate. DDT, although the first product to which resistance was reported, was used for many years before this became widespread and resistance to it seems to have developed slowly. Insects have, however, become rapidly resistant to some other chlorinated hydrocarbon insecticides even where no previous products in the same group have been used.

Application of diazinon to external surfaces for the control of house and stable flies.

While, therefore, the employment of alternative products for the control of resistant insect strains is limited and may not offer a long term answer to the problem, this use is at present a necessity where development of resistance has taken place.

Because of the very widespread use of chlorinated hydrocarbons in public health work, most of the reported cases of resistance have so far concerned these products, and strains of insects (pests, vectors) resistant to one or both of the chlorinated hydrocarbon groups are on the increase. This has focussed attention on the organophosphorus insecticides, which offer a means of maintaining control where other chemicals are sure to fail.

The early organophosphus compounds such as TEPP and parathion had the disadvantage of very high mammalian toxicity which prevented their use for public health. More recently other highly efficient insecticides have been developed with lower toxicity.

Diazinon is one of these newer organophosphorus insecticides. Discovered by J. R. Geigy S.A., Basle, diazinon is chemically, diethyl 6-methyl-2-isopropyl-4-pyrimidinyl phosphorothionate. First used in Europe for the control of DDT-resistant flies, it has now been in use in many countries for about 8 years, and has proved to give extremely effective control not only of flies, but also cockroaches, bedbugs, and other household pests, and of the larvae of Culicid mosquitoes, including species of all these pests resistant to chlorinated hydrocarbon insecticides.

Control of Flies.

The most important use of diazinon so far has been its control of flies. For satisfactory control of adult flies an insecticide must have a high level of toxicity and give long persistence when employed as residual spray, particularly on wall and ceiling surfaces. A quick knock-down effect is desirable and the regular spraying which has to be carried out, particularly in tropical countries, makes low toxicity and consequent safety in handling extremely important. The residual effectiveness of diazinon as a surface spray on inert surfaces is superior to that of many of the other organophosphorus compounds and has been amply demonstrated from several years' commercial usage, particularly in the U.S.A. and Canada, where fly control in dairy barns with diazinon is now an established practice. It has shown that the persistence of diazinon deposits in the control of house flies infesting stables is markedly superior to that of alternative products such as malathion.

Diazinon being applied to indoor surfaces in an extensive fly control campaign.

Photos courtesy of Fisons Pest Control

Diazinon has proved highly effective against fly *larvae* and its use in large scale control measures has been reported. To avoid the possibile build-up of resistance it is not desirable to employ the same insecticide against both larvae and adults at any one time and place. Where, however, the breeding grounds of flies are localised and clearly defined and provided that dosage rates, application methods and the intervals between sprays are carefully controlled, larvicidal treatments with diazinon may give results equal to or better than spraying against adults.

The Control of Culicid larvae.

Mosquitoes of the family Culicidae are almost world wide in distribution; the part played by the adults as disease carriers is well known, and control measures directed against the *Anopheles* vector of malaria, *Aedes aegypti* and *Culex spp.*, the carriers of *Wuchereria bencrofti* (which produces elephantiasis) and of dengue and filaria have had far reaching social and economic consequences.

Control measures directed towards the larvae, which are all aquatic in habit, are of the utmost importance. The use of oils on the surface of breeding waters and the development of control with chlorinated hydrocarbon insecticides have been significant factors in yielding control on a large scale.

Most of the work carried out so far with diazinon has been concerned with the larvae of the genus Culex (especially *Culex fatigans*) but there are indications that species of *Anopheles* and *Aedes* are also controlled. *Culex spp.* offer a special problem in that control of the adult by residual spraying is rendered difficult by its habits, whereas the larvae, breeding in stagnant water, particularly septic tanks, soakage pits, drainage channels

House fly imago (*Musca domestica*)

and other contaminated and usually stagnant waters, are more readily capable of attack by chemicals.

Although certain of the chlorinated hydrocarbon insecticides have been used, it should be borne in mind that these are also frequently employed as residual sprays at the same time, and the use of similar products for the control of both larvae and adults of the same species is likely to increase the danger of resistance build up. Diazinon is particularly suitable at concentrations of 1-2 ppm for the control of the larvae of certain mosquitoes, but where it is used for this purpose, its use in residual spraying directed against adults should be avoided unless combined with other chemicals.

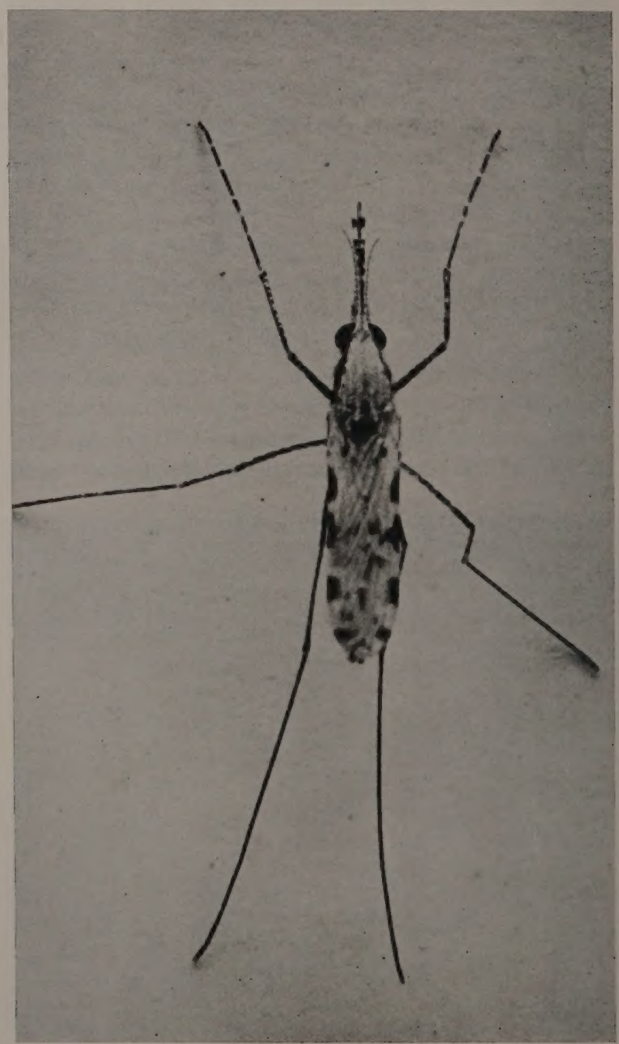
There has not so far been sufficient work on a field scale to establish the possibility of residual spraying of diazinon against *adult* mosquitoes in large scale control campaigns. In this connection it should be borne in mind that the residual persistance of diazinon, although greater than that of comparable organophosphorus insecticides, cannot be compared with the very long period of effectiveness obtained from DDT or dieldrin. In certain circumstances, however, and, of course, wherever resistance to available chlorinated hydrocarbon insecticides is known to occur, diazinon warrants extensive trial.

Control of Cockroaches.

The control of cockroaches in food processing, handling and storage establishments has long been recognised as a most important feature of public health work and successful use of the chlorinated hydrocarbon insecticides (particularly chlordane) has led to a great extension of control measures.

The development and rapid spread of resistance among cockroaches made the need for alternative chemicals a pressing and important one and diazinon has proved itself to be of value for this purpose and has become widely accepted in many countries as a safe, persistent and effective cockroach insecticide.

In the laboratory trials in the U.S.A. with non-resistant cockroaches, the dosage of diazinon required to kill test insects was only a quarter to one seventh the dosage of standard chlorinated hydrocarbon insecticides. When resistant strains were used dosage of chlorinated hydrocarbons was 500 times that of diazinon for equal results (a 50% kill of test insects).



Anopheles stephensi vector of malaria

Photo W.H.O.

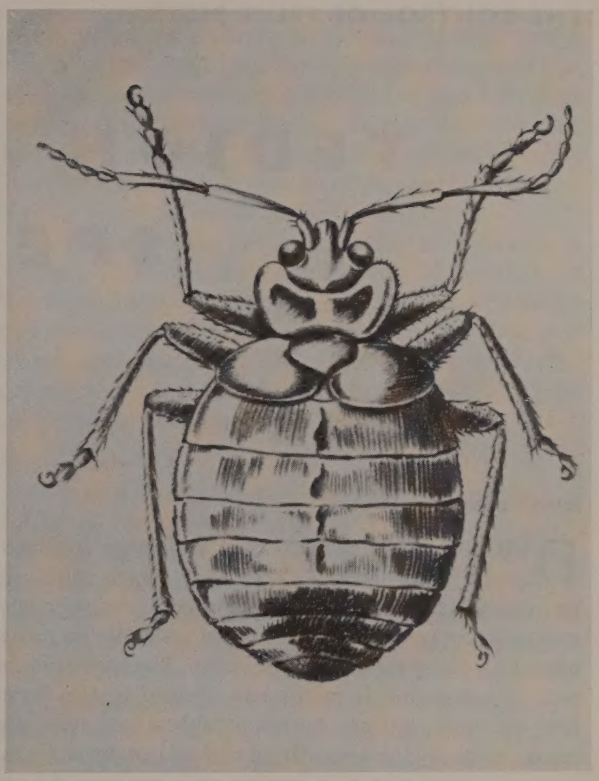
Extensive, large scale treatments by spraying contractors with diazinon in hospitals, restaurants, warehouses and hotels showed that under practical conditions excellent control could be obtained with regular treatments at approximately monthly intervals. Diazinon has now been in large scale commercial use in the U.S.A. for several years; its long residual action and its results against resistant as well as non-resistant cockroaches have contributed much to the economic control of these unpleasant pests; more recently diazinon has been introduced for cockroach control in Jamaica, Trinidad, India and Ceylon.

Control of Bedbugs.

There are two common species of bedbugs, *Cimex lectularius* and *Cimex rotundatus*, the former being common in Europe and North America whilst the latter is widespread in South Asia and Africa.

In addition to evidence that *C. rotundatus* may be involved in the transmission of bubonic plague, bedbugs cause local irritation on parts of the body where they

Adult triatomid (*Rhodnius prolixus*) carrier of *Trypanasoma cruzi* in South America



Adult bed bug (*Cimex lectularius*)

have been feeding and a consequent unsettled sleep. The pest is associated particularly with unhygienic living quarters and dirty bedding.

Before the advent of DDT and other chlorinated hydrocarbon insecticides, fumigation with hydrogen cyanide, methyl bromide, sulphur dioxide or ethylene oxide was often practised to control bedbugs. DDT and BHC provided very effective weapons and applied around the crevices and niches of walls, floors and furniture in which the insects hide gave good control and originally showed long residual toxicity.

By 1956 reports were being received from many countries (including Hawaii, Greece, Italy, Israel, China and India) of resistance developing in C. *lectularius* and C. *hemiptera* to DDT and BHC, while in 1957 dieldrin resistance was reported from the Kenya-Tanganyika border; interior spraying of houses for controlling mosquitoes has aggravated the situation.

Experimental results from a number of sources indicated the effectiveness of diazinon when compared with BHC, DDT, chlordane and dieldrin in the control of resistant bedbugs; widespread commercial use commenced in India, where much of the original trial work was done, and during the last two years has proved, under practical conditions, to give outstanding bedbug control.

TEDION SPECIFIC OVICIDE

Introduction

DURING recent decades more and more cultivated plants have been attacked by spider mites. In practice the consequences of a considerable spider mite outbreak are usually severe and can generally be recognized by a discolouration of the leaves. The harvest in the year of infestation is injuriously affected in two ways, first the mites extract nutritious substances from the leaves, secondly the assimilating surface is reduced by the damage. An infestation during the summer months induces, in fruit trees, severe ill effects on the shoot length and the quantity of blossom present in the following spring. Thus control has to be carried out as early as possible. Crops in which spider mite is generally practised today, include apples, pears, plums, citrus, vine, hops, tea, cotton, carnations and cucumbers.

The suitability of acaricides for application in practice, in addition to their direct killing properties, depends largely on a number of other factors, such as persistence, phytotoxicity and toxicity to insects, human beings and warm blooded animals.

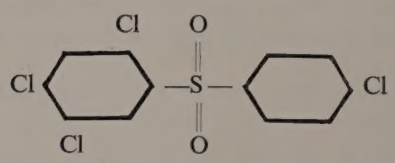
The specific acaricide 2,4,5,4′ — tetrachlorodiphenylsulphone, was developed by the laboratories of N.V. Philips-Duphar. It is a very stable chemical, resistant against alkaline and acidhydrolysis up to 150°C. The solubility in water and the volatility are extremely low.

This compound was investigated in laboratory and field experiments under the code number of V-18 later the name Tedion was chosen. Because Tedion had already acquired some reputation under the code number V-18, today the product is marketed all over the world under the name Duphar Tedion V-18.

Laboratory and field investigations during the years 1953, 1954, 1955 and 1956 provided much data on the properties of Tedion, e.g. its direct action and after-effect on spider mites on several crops, its phytotoxicity and its toxicity to insects and warm blooded animals.

Chemical Properties

Chemical name 2,4,5,4′—tetrachlorodiphenylsulphone.
Structural formula.



Tedion is a very stable chemical compound. It is extremely resistant to both alkaline and acidhydrolysis, as appears from the following data:

After refluxing 2 grammes of Tedion in respectively:

25 ml 2 *N* NaOH
25 ml of a 25% NaOH solution
25ml 2 *N* HCl
25 ml 2 *N* H_2SO_4

the substance is unchanged. Further, after heating 2 grammes of Tedion for one hour in 25 ml of concentrated HCl in a carius tube at 150°C, the compound again remained unchanged.

Tedion is unaffected by air oxidation and being resistant to both alkaline and acid hydrolysis, it is compatible with all current inorganic and organic fungicides and insecticides from a chemical point of view.

Physical Properties

Tedion is a white crystalline compound and is practically insoluble in water, as appears from the following table, which gives also solubility in the commonest organic solvents.

Melting point: 145.5 — 145.8°C.

Volatility: Tedion is only slightly volatile, as appears from the following table:

Loss in weight after	17	hours	at	20° C	nil
,,	,,	,,	,,	1	,,	,,	50° C	0.01%
,,	,,	,,	,,	1	,,	,,	100° C	0.06%
,,	,,	,,	,,	1	,,	,,	140° C	0.08%

TABLE I.

Solubility in grammes per 100g. of solvent

Solvent	Room Temperature	50°C
Water	0	0.02
Methanol	0	—
Petroleum ether 40—60°	0	—
„ „ 60—80°	0.31	1.37
„ „ 80—100°	0.42	1.59
Carbontetrachloride	1.57	7.27
Acetic acid	1.78	4.36
Methylacetate	6.5	—
Ethylacetate	7.15	—
Acetone	8.2	—
Methylethylketone	10.53	—
Xylene	11.5	22.07
Toluene	13.58	23.95
Benzene	14.8	31.30
Dioxane	22.28	38.56
Chloroform	25.5	—

Biological Properties

Direct Action

Tedion has a rather strong ovicidal, and a very strong larvicidal action but the effect against adults is weak. However, it has an influence on the ovaries of the females and laboratory tests have clearly shown that the adult females, which remain on the deposit, are no longer capable of producing fertile eggs, even when the eggs are laid on an untreated leaf. When the females do not have renewed contact with Tedion, however, the effect disappears after a certain time. The length of this period depends among other things on the strength of the residue. The actions on the eggs partly consists in an instantaneous kill of the larvae immediately after the eggs have hatched.

In laboratory tests it was also shown that Tedion is, to a certain extent, systemic. The above mentioned effect on the viability of the eggs can also be obtained by treating only the upperside of the leaf with Tedion and allowing the females to walk for some days on the underside. Due to the fact that Tedion is effective only against summer eggs, larvae and nymphs, and not against the adults, it takes a few days before the treatment shows any visible effects. After some time the adults die a natural death.

The summer eggs, present during the treatment and those that hatch later on the residue and also the larvae and nymphs, are killed, and this, together with the chemical's long persistence, affects the spider mite population to such an extent that thorough and long lasting control can be obtained.

Residual Action

In addition to direct action, residual action is also an important property of acaricides which have mainly ovicidal and larvicidal qualities. In contra-distinction to aphids, spider mites usually do not show distinct preference for newly-formed leaves and shoots, because of this, repetition of treatments is generally less necessary with these specific acaricides than with insecticides. However, the residual action of a material depends on so many factors that it is very difficult, if not impossible, to express this in a simple generally applicable figure.

In laboratory trials, very long residual action has been obtained. However, field experiments show that, in practice, in a temperate zone a residual action of 3 months is to be expected, provided that a strong growth of new foliage does not occur after the application. Under tropical and subtropical conditions the residual action will probably be shorter.

Phytotoxicity

No case is known in which any phytotoxic effect of Tedion has been proved.

In the laboratory the phytotoxic properties were examined on nasturtium (*Tropaeolum*) and on cucumbers. It is generally assumed that if nasturtium suffers no damage until 10 fold concentration of a certain product is used, there will be no risk of phytotoxicity in practice. Concentrations of 0.3, 1 and 3% active substance (in acetone) were used, in a dose corresponding to 1000 litres of spray liquid per ha., and did not cause damage.

Likewise tests were carried out on tomato, potato, broad bean, pea and French bean in concentrations of 1 and 3% respectively. After 10 days no damage to the leaves could be observed. In 1954 some field experiments on apples were carried out. In one particular test carried out on apples (varieties: Cox's Orange Pippin, James Grieve, Jonathan, Lombarts Calville), Tedion was sprayed in 10 fold concentrations. No abnormality whatsoever could be observed on leaves and fruit; the trees did not show any abnormalities in subsequent years under glass. Tedion is used on a large scale against *Tetranychus urticae* Koch on cucumbers, without ill effects ever having been observed. The compound can be applied during the whole season and even after repeated treatments no deleterious effect is observed. Also on Polyantha roses, damage has never been observed after using Tedion.

Animal Toxicity

Bees. In order to find out whether Tedion acts as a stomach poison to bees, the product was ground into a fine paste after being moistened with water, and then mixed with honey sugar dough (1:1). Bees were fed with this food containing Tedion concentrations of 0.05, 0.25, 1.25 and 6.25%. Even after 6 days no reliable difference from the control animals could be noticed, either in mortality or in behaviour. The intake of food per bee, was not different, compared with the control animals. Finally, the intestinal tracts of the bees subjected to treatment were removed and extracted. The maximum

quantity of Tedion that could be present in the intestinal tracts totalled 421.6 mg., i.e. 14.5 mg per bee. A dilution was made on the basis of this maximum. By way of control, another dilution was made of the extract from the intestinal tracts of bees not subjected to treatment, the same ratio being used. The extract from the intestinal tracts of the latter category showed no effect, whereas the extract from the intestinal tracts of the treated bees had a lethal effect on red spider eggs, independent of the dose in which it was applied.

Activity as a contact poison. The contact toxicity for bees was checked in Petri dishes which had been treated beforehand with 1, 10 and 100 mg. Tedion per sq.cm. After three days not a single symptom of poisoning could be observed. This was also the case in another test in which quantities of 1,2,4,8, and 16 grammes per sq.m. were used.

In laboratory trials Tedion, in the usual and in much higher doses, did not appear to have lethal effects on many insect species including grain weevil (*Sitophilus granarius L*), house fly (*Musca domestica L*), mediterranean flour moth (*Ephestia kuhniella Z*) and bean aphid (*Aphis fabae* Scop).

Mice, Rats, Dogs

The acute toxicity of Tedion to mice, rats and dogs, after oral as well as after peritoneal administration, was investigated. Mice were given for 10 consecutive days a daily dose of 5 g./kg. by means of an oesophageal catheter, but no toxic effect was observed. A single intraperitoneal injection of 500 mg/kg. could also be given without any injurious effect. As it is impossible to prepare easily injectable emulsions of a higher concentration, the effect of higher doses cannot be determined. Rats were given 5 g./kg. orally or a single intraperitoneal injection of 2.5 g./kg. No intoxication symptoms were observed in either case. A quantity of Tedion mixed through raw minced meat, was administered to a number of dogs on 4 consecutive days (on the first two days 1g./kg. and on the last two days 2 g./kg.) After these four days the animals were observed closely for one week, but no deviation of behaviour and appearance of these animals could be noticed.

The chronic toxicity was investigated with food experiments with rats and mice. During two months rats were given a quantity of Tedion in concentrations of 0.01%, 0.05% and 0.1% respectively (1000, 500 and 1000 ppm) mixed through the feed. The average weight increase in the different dosage groups (8 animals per group) did not show any significant difference with that of the control group.

Over a period of half a year, mice were given a quantity of Tedion in different concentrations, mixed through the food. The dosages were 0, 0.05, 0.1, 0.2 and 0.4% (0, 500, 1000, 2000 and 4000 ppm. respectively). Each group consisted of 15 mice. After three months there were no significant differences in weight between the treated animals and the control animals. Pathological investigation upon a number of animals from the highest dosage group did not provide any particular details at that period. After 6 months, the female animals of the highest dosage group (0.4%) showed a significant lag in weight increase in respect of the control group. No deviations were found macroscopically upon pathoanatomical investigation. Microscopic investigation however, revealed symptoms of a non-specific inflammatory reaction in the spleen, liver and kidneys of the animals from this group. A similar situation, but to a far smaller extent, was observed also in the male animals from this group and in the female animals from 0.2% group. Neither macroscopically, nor microscopically were any deviations observed in any other groups.

Breeding tests were carried out with a number of rats in whose food 0.1% Tedion had been mixed during a period of one month. The results as regards fecundity and litter size were absolutely identical with those obtained in the corresponding control groups.

The data on the investigation of the acute and chronic toxicity to mice, rats and dogs clearly show the very low toxicity of Tedion after oral administration. On the strength of this and also taking into consideration the very low volatility of the product, possible toxic effects after inhalation may be ruled out under normal circumstances.

Concerning a possible injurious effect on the skin it may be stated that, in employees of both laboratories and factories, who have been working with Tedion for years already, no symptom of irritation or sensibility of the skin as a consequence of this was ever noticed, not even after meticulous medical examination.

Applications

On fruit trees against summer eggs: In a year which admittedly was not favourable for the development of spider mites, one spray treatment with Tedion wettable powder or emulsifiable concentrate applied shortly after flowering at the beginning of the first "summer-egg-top" gave sufficient spider mite control to last the whole season. It is doubtful, however, whether growers are generally able or willing to choose the most favourable time for spraying. In this case more than one treatment should be carried out so that the mite population will not build up to too great an extent and so that oviposition of winter eggs will be prevented as much as possible.

On fruit trees against winter eggs: Up till now Tedion has not been effective against winter eggs and fails to give adequate control. However, it does have rather a strong action against the hatching larvae of winter eggs and application timed to coincide with the hatching of these larvae can give adequate control, especially when compared with that obtained by the application of DNC+ mineral oil against winter eggs.

Glasshouse crops: Although as a rule one application

to a fully grown crop may suffice, further treatment may be necessary if the initial application was not timed correctly or if there is a strong growth of vegetation following treatment. Tedion smoke generators are generally recommended for glass house crops.

Cotton: The general impression gained from trials is that control of the cotton spider should be undertaken as early as possible. If necessary, the treatment can be repeated 14 days afterwards. When the spider mite population develops in an already dense cotton field, which it sometimes does in an explosive manner, then dusting with a combination product of Tedion and a preparation which kills the adults must be advised.

Citrus: Tests have shown that complete control of *Metatetranychus citri* and *Tetranychus spp.*, can be obtained but good coverspray appears to be necessary.

Peanuts: Good control of *Tetranychus bimaculatus* can be obtained with the result being apparent one week after spraying and lasting for at least a month.

Almonds: Spider mites such as *Tetranychus bimaculatus*, *Anychus orientalis* and *Bryobia rubrioculus* Sch. (*B. praetiosa* Koch) can be effectively controlled with Tedion.

Flowers: Tedion will give good results against the majority of spider mites attacking flowers.

Summary

Tedion is a very selective acaricide which is toxic neither to most insects including bees, nor to warm blooded animals, It has a rather strong ovicidal action, a very strong larvicidal action and a long residual activity against mites. The conclusions drawn from more than one hundred field trials and observations from application in practice can be summarized as follows:

Normal spraying of Tedion wettable powder at a concentration of 0.02% active material is usually sufficient. The results obtained with the emulsifiable concentrate were consistently better than those obtained with the wettable powder and 0.012—0.016% active material in emulsion sprays will usually suffice. With Tedion smoke generators a dosage of 9 grammes active material per 100 m3 glasshouse gives adequate control.

Tedion in its present formulations can be successfully applied against spider mites on several crops, including: almonds, anthuriums, apples, aspidistra, azaleas, beans, cactacea, carnations, chrysanthemums, citrus, conifers, cotton, cucumbers, delphiniums, dracaena, figs, gerberas, groundnuts, hops, hydrangeas, ivy, melons, peaches, pears, philodendron, plums, roses, strawberries, tomatoes, vines and watermelons. These crops are generally infested by *Tetranychus bimaculatus* (= *T. urticae*); apples and pears by *Metatetranychus ulmi* and *Tetranychus* species, citrus by *Metatetranychus citri* and *Tetranychus* species, and conifers by *Paratetranychus ununguis*.

NOTE.—*Tedion is a trade name of Philips Duphar. As yet it has no common name.*

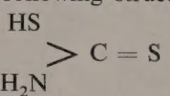
DITHIOCARBAMATE FUNGICIDES

By P. G. FENEMORE, B.Sc. Dip.Agr. Sci.
(*Charles Lennig & Co. (G.B.) Ltd.*)

Elemental sulphur and certain inorganic sulphur compounds are amongst the oldest materials known to have fungicidal properties and have been in use to control certain plant diseases for many years. It was a logical step to examine sulphur containing organic compounds for fungicidal action, and in the early 1930*s the outstanding activity of certain dithiocarbamates was discovered. Since that time the dithiocarbamates have risen to the position of being the most widely used organic fungicides for crop protection throughout the world and the range of diseases and crops on which they are employed is now an extremely wide one.*

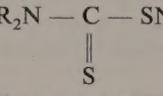
Chemical Constitution

THE dithiocarbamate compounds which have become established in commercial usage can be divided into three main chemical groups, but all can be regarded as derivatives of the hypothetical dithiocarbamate acid with the following structural formula:-



(*a*) *dialkyl dithiocarbamates*

Historically this was the first group to be discovered the first published work appearing in the early 1930s. However, no significant commercial development took place before the war. The group is characterized by the structural formula:-



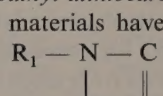
The highest fungicidal activity is given by compounds in which methyl groups make up the alkyl radical. With higher homologues fungitoxicity decreases rapidly. The sodium salt, although highly fungitoxic, is very water soluble and of little use in practice as a protectant fungicide.

Two fungicides within this group have achieved significant commercial status. These are zinc dimethyl dithiocarbamate with the common name ziram, and the corresponding iron salt, ferbam.

The fungicidal range of action of ziram and ferbam is not as wide as other types of dithiocarbamates and for most purposes they have been replaced by more recently developed materials. Ziram still finds a certain place in orchard spray programmes against apple scab and is more favoured on some varieties and in certain fruit growing areas than in others. The main use to which ferbam is now put is for the control of rust fungi on some crops. The fact that it is black in colour and leaves a prominent visible deposit is a practical disadvantage under certain conditions.

(*b*) *monoalkyl dithiocarbamates*

These materials have the general formula:-



Only one member of this group has so far gone into practical use. This is sodium methyl dithiocarbamate, to which the common name metham sodium has been assigned in Great Britain. It is comparatively stable in water solution over a certain range of concentration and several different commercial preparations containing somewhat different percentages are available.

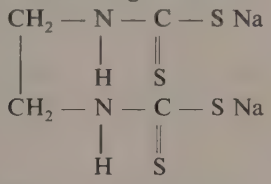
Sodium methyl dithiocarbamate has potent fungicidal properties but is also extremely phytotoxic. Its use is thus restricted to pre-planting treatment of soils. Besides control of many soil borne fungi, metham sodium also gives a high degree of weed control and in addition has effect against soil nematodes and insects. This polyvalency of action makes it a strong contender for the treatment of glasshouse soils, and its use for certain outdoor crops also will certainly increase in the future, where the cost of application can be justified.

It has been demonstrated that the biological action of sodium methyl dithiocarbamate is due to methyl isothiocyanate (CH_3NCS) which is produced when it is applied to soil in the presence of water. This breakdown product is comparatively volatile and only when it has completely dissipated from the soil can planting or seeding safely take place. The length of this period

depends primarily on temperature, but soil type, method of application, and treatment of the soil after applying metham sodium are also important.

(*c*) *alkylene bisdithiocarbamates*

This is by far the most important group of the dithiocarbamates in terms of quantities of materials used in practice. Chemically they can be considered as two monoalkyl dithiocarbamate molecules linked together to give the following structure:—



The sodium salt as illustrated, (nabam) was in fact the first member of this group to go into commercial use. Used alone, however, it gave variable performance and poor persistence, until it was discovered that these shortcomings could be overcome by the addition of zinc sulphate to the spray tank immediately before application. Nabam is sold as an aqueous solution, and the addition of zinc sulphate precipitates the zinc salt of the dithiocarbamate. This preparation has been very widely used in the United States until recently for the control of Late Blight (*Phytophora infestans*) and Early Blight (*Alternaria solani*) of potatoes.

Zinc ethylene bisdithiocarbamate (zineb) is now almost entirely used in the form of a ready formulated wettable powder and this material is certainly the most widely used of the dithiocarbamates at the present time. Zineb may also be used satisfactorily in dust form for a number of purposes.

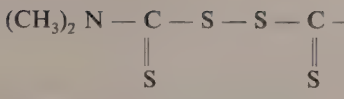
The range of fungi against which zineb is effective is a wide one. Besides Late and Early Blight of potatoes and tomatoes it controls downy mildew of vines and various vegetable crops, apple scab and rust diseases, to name only a few.

A third member of the ethylene bisdithiocarbamate group has recently come to the forefront. This is the manganese salt, maneb. Although more difficult to manufacture in a stable formulation than zineb, it has a number of advantages particularly for the control of potato late blight. As it is toxic to *Phytophora* spores at lower concentrations, better blight control is obtained in the field, which results in higher yields. More effective protection of tubers against blight infection is also given.

Maneb is not likely to replace zineb entirely however, as it does not appear to be quite so safe to use on some crops, for example apples.

(*d*) *Thiram*

The fungicide tetramethyl thiram disulphide (*Thiram* or *TMTD*) is sometimes included in the dithiocarbamate group, as it can be regarded theoretically as being derived from two dimethyl dithiocarbamic acid molecules to give the following structure:-



Thiram has quite a wide range of fungicidal action but for many purposes other dithiocarbamate fungicides are most effective. Its main use at the present time is as a fungicidal constituent of seed dressings. It is also still used to some extent as a post-blossom scab fungicide on fruit.

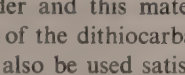
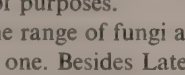
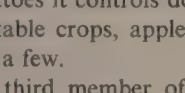
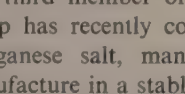
Mode of Action of Dithiocarbamate Fungicides

Although a very considerable amount of research has been undertaken to investigate the mode of action of the dithiocarbamate fungicides, this question is not as yet very fully answered. It is clear however that biologically the dithiocarbamates fall into two quite distinct groups which certainly act in different ways.

In Table 1 the fungitoxicity of four closely related dithiocarbamate compounds is given in parts per million concentration required for growth inhibition of four fungi.

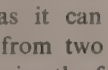
TABLE 1.

Fungitoxicity of Structurally Related Dithiocarbamates

Compound	Growth inhibiting concentration in ppm.			
	Botrytis allii	*Penicillium italicum*	*Aspergillus niger*	*Rhizopus nigricans*
	0.2	0.2	10	0.2
	1	2	20	100
	50	50	1000	1000
	1	0.5	2	10

It can be seen that the substitution of a methyl group on the nitrogen atom by hydrogen has a marked effect on toxicity and it is apparent from such investigations that the two groups of compounds act quite differently biologically.

(1) Compounds containing the structure



i.e. monoalkyl dithiocarbamates (b) and alkylene bisdithiocarbamates (c)

Such compounds, because of the relative chemical instability introduced by the presence of a free hydrogen atom on the nitrogen, can produce isothiocyanate groups (R—NCS) especially in the presence of heavy metal ions. These isothiocyanate groups in turn probably interfere with thiolsystems within the fungal cell.

(2) compounds containing the structure

$$R_2N - C(=S) -$$ i.e. dialkyl dithiocarbamates (a)

Although the mode of action of compounds belonging to this group is quite clearly different from the former, the actual biochemical processes involved are very little understood.

Considerable information has been accumulated as to the factors which determine fungitoxicity. For instance, if the alkyl groupings are increased in chain length the biological activity falls off rapidly as the following table shows.

TABLE 2

Fungitoxicity of compounds $R_2N - C(=S) - SNa$

R	Growth inhibiting concentration in ppm.			
	Botrytis allii	*Penicillium italicum*	*Aspergillus niger*	*Rhizopus nigricans*
CH_3	0.2	0.2	20	0.5
C_2H_5	1	2	10	5
n–C_3H_7	200	200	200	1000
n–C_4H_9	1000	2000	2000	1000

The actual process of biological action of these compounds remains to be clarified however. When a better understanding of this question has been achieved the production of still more effective materials should be of course facilitated.

Conclusions

Sufficient has been said in this brief review, to make it apparent that the dithiocarbamate fungicides have a wide range of action against many important crop diseases and at the present time occupy a prominent position in commercial usage.

They are comparatively simple organic chemicals and the materials used in manufacture are commonly available industrial chemicals.

Improvements on the present dithiocarbamate materials are certainly to be expected, but as protectant fungicides it seems unlikely that they will be surpassed for efficiency and economy for quite a long time to come.

LEADER *Continued from page 251.*

Mr. Waddington states:-

"Most cases of fish mortality due to agricultural chemicals in this area have been caused by sheep dipping fluids containing DDT, Gammexane or Phenol. I would say without hesitation that almost all incidents have followed carelessness by the farmer. We have found that many farmers thought that DDT and Gammexane were non-poisonous. This may have arisen from literature circulated by the manufacturers who state that the non-arsenical dips are non toxic to human beings. The cases quoted in our annual reports have all been carefully authenticated and most occured in remote moorland areas where there was no other likely source of pollution.

"Finally, agricultural lime when carelessly applied to land has been responsible for killing large numbers of salmon and trout; in one case last year salmon parr, trout and other fish were killed for a considerable distance below the ford where a vehicle carrying lime had crossed the river.

"We are naturally concerned about the number of new agricultural chemicals now appearing on the market and are hampered in many cases by an absence of knowledge of their toxicity to fish life and (more important) to human beings in cases where chemicals are used in or near public water supply catchment areas. It would be of great assistance if all manufacturers agreed to submit new compounds to the Ministry of Agriculture for testing so that all interested parties, eg. river boards, could have information available on products appearing on the market. We are often approached by farmers and spraying contractors and cannot always give accurate guidance.

"In general we believe that if due care is taken by farmers most of the troubles we have experienced can be avoided but active co-operation by the manufacturers could be of great benefit to us."

In a second letter Mr. Waddington states:-

"I.....would like to emphasise that many manufacturers, of course, already submit samples of their products to the M.A.F.F. but it appears, in some cases, that products are still appearing on the market before any evaluation of their toxicity to aquatic fauna has been carried out. We in Scotland would welcome a permanent liason between the manufacturers and river purification boards on this question."

Note that Mr. Waddington has carefully ascertained the authenticity of his cases and has rightly come to the conclusion that troubles can be avoided with due care. Moreover, he is quite willing to discuss the problem with manufacturers.

Get rid of pests -

fumigate with

'Embafume'

In silos, stores, mills, barges, ships' holds or any space which can be made gas-proof, 'Embafume' destroys almost every insect pest and parasite, from egg to adult stage. Rats and mice are also killed at very low dosages.

'Embafume' penetrates sacks, wooden boxes and fibreboard cases, and it is widely used in the fumigation of most foodstuffs, including cereals, fruits and vegetables; textiles, timber, and many other products.

It is also used for glasshouse, soil and other horticultural fumigations; seeds can be treated without harming germination.

Detailed information is available on request

'Embafume' METHYL BROMIDE
TRADE MARK BRAND

AN M&B BRAND PRODUCT

MANUFACTURED BY MAY & BAKER LTD - DAGENHAM - TEL: DOMinion 3060 . EXT. 342

MIXTURE RECOMMENDED FOR THE FUMIGATION OF STORED PRODUCTS IN INDIA

THE insect problem in stored food grains should be tackled from two angles. First of all the existing or resident infestation must be wiped out. Secondly measures should be taken to safeguard against re-infestation either from neighbouring or incoming material.

After several years of Research the Central Food Technological Research Institute, Mysore, have decided to recommend the following procedure—named the Durofume process—for use in India.

Curative treatment

There is no one fumigant whichwill satisfy all the requirements of an ideal fumigant, for example Methyl Bromide whilst it has a high toxicity to insects and excellent penetration powers, has been known to leave residues especially in protein rich materials. In addition its lack of perceptible odour presents a hazard to the operators, who can only be sure of its presence by using a halide detector (or one of the more recently developed detectors).

Ethylene dibromide on the other hand has a characteristic odour by which it is easily recognised, it is also highly toxic but unfortunately its penetrating properties are poor.

Realising the disadvantage of using a single fumigant, a variety of fumigants were screened for their compatability and joint action, and the value of a mixture of ethylene dibromide and methyl bromide for practical disinfestation was immediately recognised. Application on a commercial scale has resulted in rapid disinfestation and a high penetration in bulk. The mixture is highly effective against a wide spectrum of insects giving control of pre-adult as well as adult stages of such resistant species as *Tribolium castaneum* and *Trogoderma granarium*. All proportions of the mixture are more toxic than either of the fumigants used alone, and samples drawn after fumigation have remained insect free after the incubation period under accelerated conditions. The residues estimated as total bromide have always shown unexpectedly low values, and are far below the residues normally present after using ethylene dibromide or methyl bromide as single fumigants.

Other advantages of using the Durofume process are, aeration is quicker than with ethylene dibromide fumigation; the characteristic odour of ethylene dibromide serves to warn operators against undue exposure; it has been observed that the gas masks, which have to be worn by operators, can be used for a longer period than with either ethylene dibromide/carbon tetrachloride or methyl bromide fumigation, and any good gas proof sheets of rubberised cloth or PVC coated fabric can be used for enclosing the area to be fumigated.

Dosage Rates and Mode of Application

For cereals, pulses and spices a 1:1 mixture at the rate of 2 lbs./1000 cu. ft. is recommended. An exposure period of 48 hours should generally be adopted. If the temperature is more than 26°C. 36 hours exposure is sufficient. A 1:3 mixture of ethylene dibromide; methyl bromide applied at 1:5—2 lbs./1000 cu. ft. is suitable for disinfesting oil seeds, the exposure period being from 36—48 hours. In the case of milled cereals 3 lbs./1000 cu. ft. of 1:3 ethylene dibromide/methyl bromide mixture should be used over an exposure period of 48—72 hours, depending upon the nature of the fumigation chamber, etc.

After making the area to be fumigated air tight, ethylene dibromide is first administered through a system of tubing having exit points 6—8 ft. apart on the stack. Then the methyl bromide is administered through the same tubing. The discharge can be measured by weighing the gas cylinder on a suitable balance, hence it is possible to apply correct proportions of the mixture. More recently pressurised packaging of ethylene dibromide and methyl bromide in a single cylinder has been achieved, and allows safer and easier application.

In practise the Durofume fumigant combination has been found to be the cheapest and most efficient method of disinfesting food grains, oil seeds, oilseed cakes, milled products, coffee, dry fruits, macaroni products, and many other commodities.

Prophylactic treatment

It is a wise practise to repeat fumigation of food grain bags with an ethylene dibromide/carbon tetrachloride

mixture (at the rate of 25—35 lbs./1000 cu. ft.) every 3 months. The infestation can also be prevented by treating the outer surface of the stack with a suitable insecticide. The insecticide formulation used will vary according to the commodity stored and the sacking used. Close weave sacks such as A-twill and B-twill can be sprayed directly with a high viscosity oil based lindane formulation without the risk of contaminating the grain inside. A suitable lindane formulation for this purpose uses a mixture of Dutrex 3, batching oil, linseed oil and ground nut oil as the carrier. The formulation is sprayed on to the sacks through a low volume nozzle at 30—35 p.s., pressure at the rate of 2-2.5 ml per sq. ft. of the back stack surface. This gives an application of 50 mg. of lindane per sq. ft. and exerts a prophylactic effect for 4—5 months. Repeated spraying at 3 month intervals is, therefore, recommended.

As a supplementary measure a formulation based on lindane and malathion should be sprayed from time to time on the wall and around the stacks. If the issue of bags is done from the remotest column of the stack and is followed up by spraying with the lindane/malathion oil based formulation on the exposed surface, it will yield excellent results. Routine spraying with pyrethrum and piperonyl butoxide whenever new stacks are erected or stacks are disturbed, will also give same protection from cross infestation.

In the case of bags having high weave clearances such as the DW and Hessian types, direct spraying on the grain bag surface is not desirable. In such cases treated gunny cloth is spread over the bag stack to prevent cross infestation. Excellent results have been obtained using a gunny cloth (which can be made by stitching old gunny bags together) treated with an oil based formulation containing DDT and BHC. The particular formulation (Durobase 2) used for treating the gunny sheet remains effective in controlling pests for a period of 10—12 months and is especially effective against *Ephestia* species in stored grains and milled products.

CORRECTION

Due to an error some copies of our August issue do not carry the name of the author of the article "INTERFACIAL PHENOMENA in PESTICIDE APPLICATION" (*Pest Technology* **2** (II) pps. 239-243). We sincerely apologise to the author, Mr. W. Duyfjes, Dip. Ing., N. V. Philips—Duphar, Nederland, and to our readers for any inconvenience which may have ensued.

REFLECTIONS ON THE CONTROL OF THE POTATO ROOT EELWORM

(Heterodera rostochiensis)

THE POTATO ROOT EELWORM or golden nematode was first observed as early as 1881 but it was some 20 years later before scientists began to take any notice of its effects. Believed to be indigenous to Peru it now occurs throughout Western Europe, Norway, Sweden, Russia, Algeria, Israel and Japan. It has also been found in all the Central and South American countries and, in the U.S.A., it infests some 27,000 acres mainly around Nassau and Long Island. However, the greatest threat is to the potato industry in temperate climates such as Western Europe.

Like many of the other nematodes of the genera Heterodera the eggs of the golden nematode are very resistant to adverse conditions due to the protection afforded by the cyst which is in fact the dead skin of the female. The eggs remain in the soil for many years and viable cysts have been found in soil which has not borne potatoes for 12-15 years and in the west of Scotland viable cysts have occured after a break in potato growing of 26 years. The possibility that they may have developed in some other host such as bitter, silverleaf and purple nightshade or other wild relatives of the potato (*Solanum* spp) or tomato (*Lysopersicon* spp) cannot be ruled out but nevertheless eggs are capable of lying dormant on the soil for 12 years or more to hatch when potatoes are planted.

Egg hatching is influenced by a number of factors but the main cause is the presence in the soil of substances—root diffusates—produced by a suitable host plant. Naturally the discovery of the hatching factor raised the hope that the eelworms could be made to hatch in the absence of a suitable host. This can be done biologically by growing potatoes or tomatoes and lifting them before the eelworm has completed its life cycle. Alternatively the resistant weed, *Solanum nigrum* or resistant varieties of potatoes, both of which have active root diffusates, may be grown, causing the eggs to hatch but preventing the juvenile nematodes from entering the plant. However, this will only produce a depletion in the soil population of 25% over an annual natural depletion of 50% or equivalent to a gain of 1 year in a normal 4 year rotation. Moreover, the resistant hybrid potatoes so far developed are not resistant to all populations of the potato root eelworm.

The next obvious step was to produce the hatching factor synthetically but before this can be contemplated the substance's chemical composition must be accurately determined. Unfortunately this has not yet been done mainly due to the fact that it is only present in the plant in minute quantities. Again should such a synthetic factor or some stabilised derivative of the natural compound with hatching power become available it is unlikely that they could be distributed artificially through the soil as efficiently as the natural distribution through the roots. Thus it would be surprising if a 25% reduction were attained and in his excellent studies of eelworm populations Grainger has shown that the level of infestation would have to be very low before effective control would result from the use of the hatching factor.

Fumigants.

Soil fumigants such as DD, Nemagon, metham sodium etc. have not been as successful in the control of cyst nematodes as they have in the control of nematode pests of perennial crops. In warm countries DD has been known to give 90 - 95% control of potato root eelworm but on occasions the remaining population has built up so rapidly—in some cases quicker than if it had not been used—that it cannot be used on its own and it is only recommended for use in conjunction with normal crop protection. For DD to be effective a high soil temperature is necessary and as these temperatures are not realised in this country it is limited to a restricted use in greenhouses where the high temperature required

can be created artificially. More research has to be done before the true value of these compounds for the control of potato root eelworm can be established.

Rotation

The recognised method of dealing with the potato root eelworm problem is the long rotation. The success of this method is due to there being a natural annual reduction in the eelworm population. This depletion is greater in high temperatures and low humidity so that in the warmer, drier parts of Great Britain the annual rate of depletion is 50% or more but in the cooler, damper areas such as the west of Scotland the eelworm population is only reduced by 18% every year. As a crop can only be grown successfully when the eelworm population is below a certain level it can be seen that, starting from the same population level the eelworm population of an area with a depletion rate of 50% will be reduced to the necessary low level in less time than an area with an 18% depletion rate. Of course in both cases the higher the population level the longer it will take for it to be reduced to one at which a crop can be planted. Thus for a given area a knowledge of the original eelworm population and of the natural depletion rate will allow us to determine the minimum interval between the planting of successive crops. In other words to determine the most appropriate rotation period of each individual area.

Mercury Compounds.

A most recent and promising method of control has been developed by Dr. J. Grainger of the West of Scotland College of Agriculture. Following extensive pot and field experiments with various compounds of mercury it was found that the potato root eelworm and several soil diseases could be controlled by the application of mercury compounds at the rate of 5lbs. Mercury equivalent per acre. For control in the field the mercury has to be distributed evenly within $\pm$ 20% of the dose in all parts of the soil mass to a depth of 9 inches. In order to obtain this even distribution there are two main requisites, first the mercury compound has to be incorporated with a suitable diluent so that there is a sufficiently large bulk to fascilitate proper handling, secondly efficient equipment to distribute the material must be found.

Regarding the former, yellow oxide of mercury was chosen as the best compound for making into a dust and Filler G. A. was chosen as the diluent. The dust prepared from these two materials had the following characteristics:- type, diatomaceous; particle size 1-27 microns, mean 9 microns 99% through 200 mesh; angle of repose 40 degrees undisturbed, 35 degrees when shaken; weight per cubic foot 65 lbs fluffed, 77%lbs. compacted; percentage by weight of mercury 0.54. The dust is one of the heaviest used in practice and was chosen deliberately with the intention of using fertilizers as carriers. The use of fertilizers now seems impracticable and investigations have recently been directed towards finding a lighter dust which would reduce the cost of application. The search has so far led to the choice of Vermiculite as diluent in place of Filler G.A., as it is lighter, cheaper and also safer because no dust cloud arises during treatment.

Regarding the second requisite, a great deal of time was spent on experiments with various types of equipment in order to determine the best method for distributing the dust. The result was the development of hybrid machine named the "30 inch. Howard-Allman-Auchincruive Soil Mixer". The machine consists of an Allman 'Speedisi' duster and a Howard Rotavator, which was the only implement giving the high standard of mix required. The duster is composed essentially of a hooper, booster fan and a series of polythene tubes which convey the dust to a number of duck-foot tines and baffle plates situated just in front of the rotavator unit. In operation, therefore, dust is applied from the baffle plates onto the soil surface and from the duck-foot tines at a depth of 7 inches. The rotavator unit then thoroughly mixes the dust with the soil to a depth of 9 inches.

During the past six years this machine has been used to treat various experimental plots with differing soil conditions at an application rate of 5lbs. mercury equivalent in 9 cwt. Fullers Earth per acre. This has resulted in 75-85% reductions in eelworm populations and increase in yield from 7 tons per acre to 11 tons per acre. More recent trials have shown that, with two slight improvements concerning the more even spreading of dust within the machine, treatment at 2½lbs. mercury equivalent per acre is superior to that at 5lbs.

Although it is possible to control the potato root eelworm by this method its commercial use in the future will be determined by factors unconnected with the success of the machine. First of all it has been shown by Dr. Grainger that it is not the number of eelworms killed that is important but the number that remain alive after treatment. Thus economic control by this method—and probably any other—cannot possibly be obtained unless the eelworm population before treatment is below 1.2 cysts with contents per gram of soil. Should the population be higher it would be necessary to wait until it has been reduced to this level by natural depletion before carrying out treatment. Secondly complete eradication could only be envisaged by a series of three treatments separated by farm rotation. The first of these is never very spectacular and so it would be difficult to demonstrate the beneficial effects to the farmer. For these reasons it may be some while before we will know the true value of this method.

NEWS

Determination of Pesticides.

The February and May issues of the *Journal of the Association of Official Agricultural Chemists* **43,** 1 and 2 contains a number of papers of interest to research laboratories and pesticide manufacturers.

They include chemical methods of detecting and determining pyrethrins, piperonyl butoxide, malathion, parathion, dithiocarbamates, sabadilla alkaloids, rotenone, sodium trichloracetate, dalapon and ester and amine salts of 2, 4-D. Methods are also given for determining DDT in dusts and in milk, methoxychlor in extracts of fruit, vegetable and animal fats and elemental sulphur in pesticide formulations.

For the biologist there is a paper on micromorphological identification of fragments of mill and grain moths contaminating grain, grain products and other stored produce and another describing a method of insecticidal bioassay using houseflies.

The Microsol 303T Fog Generator

New Wheeled Spraying Unit for Pest Control.

A new mechanical spraying unit which comprises a 5 gallon gravity-feed tank, and electric motor-driven mechanical Fog Generator mounted on a wheeled chassis of tubular steel, is now being manufactured by Silver Creek Precision Ltd., Willow Road, Poyle Trading Estate, Colnbrook, Bucks. (Tel: CN8 2588) It is the Microsol 303T.

The unit has a very wide field of application and models are already being used in food warehouses, kitchens, cargo holds, ships' galleys and greenhouses.

It is designed to provide an effective means of controlling bacteria and pests in large buildings, such as factories, warehouses and food stores. It is highly manoeuvrable and can be operated by one man.

The unit has a spraying output of up to 25 gallons/hour, and it generates particles of controllable size from 10-120 microns.

Suitably formulated chemicals flow from the tank by gravity feed into the Microsol Unit. Here, the liquids are fed into a five-disc head through a distributor and fractionized into billions of droplets. A high speed fan, working on the same motor-shaft as disc system, shears off the droplets as they emerge, and so ejects them as a turbulent, penetrating fog. This travels wherever air will go, behind pipes, under radiators, above shelves, and so it quickly penetrates extensive areas.

The unit has a maximum throw of 165 feet, weighs 75lbs., and it stands 43 inches high. The electric motor is 1/3 h.p. precision built Universal 110 volts, or 230/250 volts. Voltages down to 50v can be supplied to special order.

New Demineralised Water Unit for Laboratories

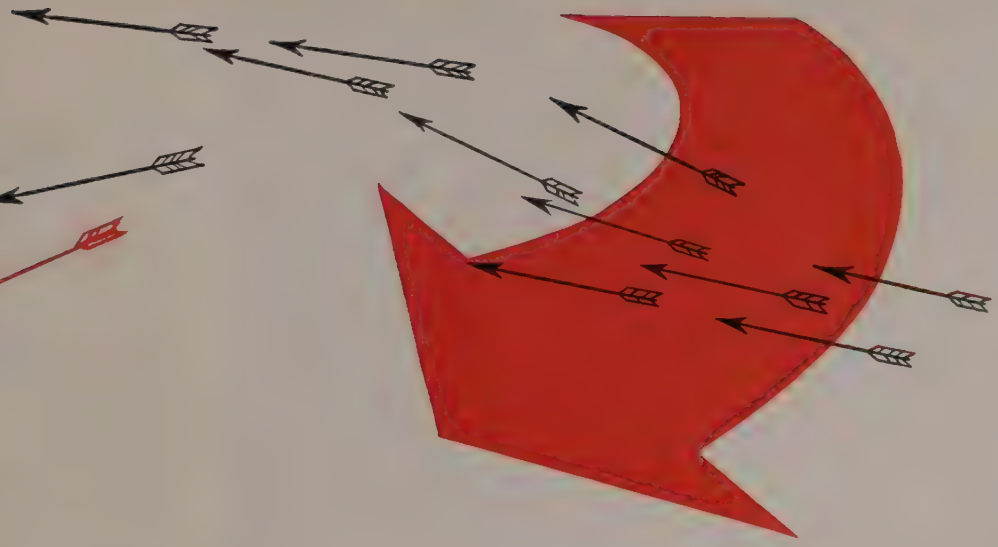
The Mark 6 Portable "Deminrolit" designed and manufactured by The Permutit Company Limited can convert up to 12 gallons hourly of clean cold water into demineralised water having a conductivity of less than 1.0 reciprocal megohm per centi metre: the quality of water produced by the Unit conforms to the "Purified Water" standard of the British Pharmacopoeia, 1958.

The new Portable "Deminrolit" is a mixed bed ion exchanger. The ion exchange materials used are "Zeo-Karb 225" and "De-Acidite FF": these are manufactured by Permutit at their Chemical Production Division in South Wales.

The Mark 6 Portable "Deminrolit" manufactured by the Permutit Company

The Unit is designed for simple and reliable regeneration on the spot. A Conductivity Tester is fitted which continuously monitors treated water quality. Constructed as a free-standing unit of robust, non-corrodible construction throughout, the Mark 6 Portable "Deminrolit" is suitable for workshop as well as laboratory conditions. No expensive plumbing is necessary, the Unit being simply connected by flexible hose.

The Mark 6 Portable "Deminrolit' is an addition to the already widely used range of Portable "Deminrolit" Units. For greater outputs of very pure water, Permutit design and manufacture industrial plants for dealing with practically any quantity of water.



a killer you don't have to handle with care

SEVIN Insecticide—a new kind of pesticide—Powerful Enough to Kill Resistant Insects, Yet Safer to Handle than DDT.

Years of Union Carbide research has developed a new kind of insect killer, SEVIN Insecticide, that is chemically different from any other insecticide now in commercial use. SEVIN is a powerful carbamate and has proved highly effective against fruit and vegetable insects, forest and ornamental pests, animal ticks and lice—*even those insects that have developed resistance to other insecticides.*

SEVIN Insecticide potency lasts longer in the field and fewer sprayings are required to do an effective job. SEVIN appears less toxic to humans and animals than DDT. Field workers can continue operations immediately after a SEVIN spraying.

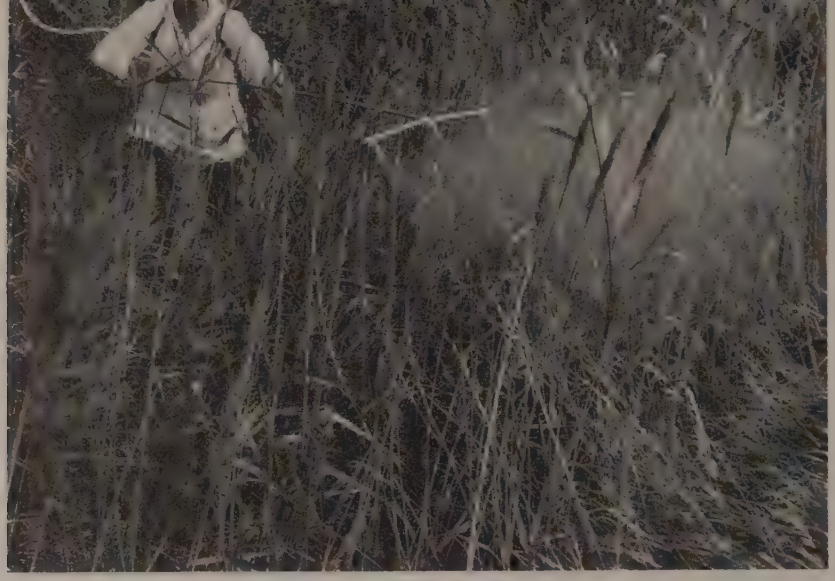
SEVIN has no objectionable odor and is compatible with most other chemicals so you can combine a complete insect control program in one formulation.

Find out how SEVIN can help you control insect damage and improve the quality of your crops. Write today for detailed information CPT 9 to the Chemicals Department, Union Carbide International Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y., U. S. A., Cable Address: UNICARBIDE, New York.

PHYSICAL PROPERTIES: CHEMICALLY PURE 1-NAPHTHYL N-METHYLCARBAMATE IS CHARACTERIZED BY:

appearance	white, crystalline solid
odor	essentially odorless
melting point	142 deg. C.
vapor pressure	less than 0.005 mm. Hg at 26 deg. C.
density	1.232 at 20/20 deg. C.

UNION CARBIDE
TRADE MARK
Chemicals



Chemical Reed Control

(*Photos Dow Agrochemicals*)

Demonstrating the use of a knapsack sprayer and three nozzle hand lance.

Most people who have lived in the low lying farming areas of Britain will know full well of the perennial and costly problem of keeping water courses, dykes and drains, which of necessity criss-cross the countryside, from becoming overgrown with reeds that threaten to prevent the free flow of drainage water.

Hitherto, the only feasible method of dealing with these weeds has been hand cutting, mechanical cutting in the vast majority of cases has proved impossible. Moreover hand cutting, apart from being an arduous and backbreaking task, is a costly business with the usual rate being from £40 - £80 per mile or 8/- per chain.

The advent of chemical weedkillers, naturally raised the hope hand cutting could be replaced by the use of these weedkillers. Of the chemicals which have been and are being tested for aquatic weed control dalapon holds great promise due to the fact that it selectively controls monocotyledons, the group of plants to which the reeds and kindred aquatic weeds belong. It is these latter plants which form the bulk of the aquatic weed problem in dykes and ditches - at least in Great Britain.

This then, is the background to the demonstration of reed control recently given by Dow Agrochemicals who (no doubt subscribing to the old and tested adage that once shown is worth ten tellings) invited engineers and officials of river and internal drainage boards, farmers, fishery interests and others, to see and judge for themselves the value of Dowpon, (Dow's formulation of dalapon) for the purpose of controlling aquatic weeds.

First item on the agenda was a demonstration of spraying equipment suitable for applying the chemicals. This equipment included a knapsack sprayer, a standard low volume sprayer with a tank capacity of 60 gallons, a high volume tractor operated sprayer with a tank capacity of 300 gallons and operating at a pressure of 200 lbs./sq. inch (chosen as an example of contractor's spraying equipment) and a Land Rover experimental spraying unit which had a tank capacity of 20 gallons. Emerging from the demonstration it was seen that with the three mechanised units a three nozzle hand lance attached to the unit by a considerable length of hose gave the best coverage of the ditch which had a 6 ft. wide growth of reeds. (see photo). One was also impressed by the fact that the time taken for chemical treatment (varying from 30 seconds to 1 minute 30 seconds per chain) was considerably less than that which would be required for hand cutting.

Visitors were also shown around three test sites on which the drains had previously been treated with Dowpon. At the first site, Wooton Marsh Farm, King's Lynn, six, 30yd. lengths of farm drainage ditch, which at the time of application was choked with *Phragmites communis*, had been sprayed at rates of 5½, 4½, and 3½ ounces per chain, and at a cost (for the chemical) ranging between 3/- and 1/11d. per chain. A high volume power sprayer fitted with a hand lance was used for the operation. Application at these rates could be considered successful for, since the time of treatment, which was carried out in 1958, there had been no regrowth of reeds. However, during the last year certain broad leaved weeds appeared, which being dicotyledons were not controlled by Dowpon. These weeds were sprayed in July 1960 with Kuron S a herbicide, containing silvex (2,4,5-TP), specially formulated for the control of aquatic broad-leaved weeds. Adequate control appeared to have been attained.

On the second site, at Lord's Drain, Weston, Spalding, the trials had been carried out by the South Welland Internal Drainage Board. Two sections, each 7chains in length, of a 9ft. wide ditch had been treated using a knapsack sprayer. For the first section a dosage rate of 1lb. of Dowpon in two gallons of water was used, this amounts to the use of 2½ ozs. of Dowpon per chain at a cost, for the chemical, of 1/3d. per chain. Although treatment was only carried out on 31st May, 1960 it appeared that practically a 100% kill of reeds had been obtained. For the second

section ½lb. of Dowpon in 2 gallons of water had been used to treat 7 chains. This represented a dosage rate of 1¼oz. Dowpon per chain and a cost for the chemical of 7½d. per chain. Not unnaturally the results obtained at this rate were not as good as those obtained in the first section.

Commenting on the results Mr. H. W. Price, Assistant Engineer to the Welland River Board, stated having obtained control of the reeds growing in the ditch by using the higher dosage rate, it is likely that the grass growth on the bank will be checked in future with a light application of Dowpon (perhaps 2½–4lbs. per acre) carried out in March each year. It is hoped that this will reduce the need for cutting the sides of the ditch without destroying the grass, thus the binding properties of the roots in the batters will not be impeded.

On the third site, namely Sam's Cut, Wissington, trials had been carried out by the Great Ouse River Board who were confronted by a considerably greater problem than that occuring on the other two sites. The growth in the 11ft. wide ditch was not confined to reeds but included considerable quantities of assorted aquatic weeds viz. *Phalaris, Glyceria, Apium and Epilobium* spp. On the 20 chains of ditch treated, Dowpon was applied at 30lbs/acre/8oz. per chain) and supplemented with 2lbs/acre (0.6oz/chain) of MCP A for the first 10 chains and a similar quantity of Kuron S for the second section. Treatment was carried out in June 1960, using a hand lance attached to a Land Rover spraying unit which incidentally allows 10 chains to be treated in 30 minutes.

The Dowpon/Kuron S (for broad leaved weeds) combination proved highly successful but the Dowpon/MCPA combination although giving some control was not "up to scratch" on this particular occasion.

It is stated that similar successful results to those acheived on the three aforementioned sites, have been and are being obtained in numerous other trials which are being carried out all over the country from Scotland to Cornwall and from Lincolnshire to Wales.

On a final note to those concerned with safety dalapon is not toxic to fish at the dosage rates used.

At present Kuran S is only available in this country in trial quantities.

The photograph above shows a six foot wide main drain that was sprayed with Dowpon in September, 1958, at a rate of 25 lbs. in 150 gallons of water per acre. Compare with the untreated drain from the same locality pictured below

NEWS

Opening of New Laboratory and Administration Buildings of the Ashburton Chemical Works.

The President of the Board of Trade, the Rt. Hon. Reginald Maudling M.P., will open on Friday 14th October 1960 the new laboratory and administration buildings of Ashburton Chemical Works Limited, Trafford Park Manchester.

Ashburton Chemical Works Ltd. is one of the manufacturing companies of the Geigy group in Britain, which is itself a part of a world wide organisation whose parent company was founded in Switzerland in 1758 and has since been continuosly active in the chemical industry. Ashburton Chemical Works Ltd. are manufacturers of textile and plastics chemicals and pharmaceutical products, and the present extension marks the completion of a stage whereby the laboratories, drawing and administrative offices and welfare facilities, hitherto scattered over the 20-acre site of the works, have been concentrated in a single set of buildings.

The buildings have been specially designed for their various purposes and themselves form a notable feature, architecturally, in the Trafford Park landscape.

Geigy need no introduction, of course, as the discoverers and manufacturers of DDT which is still used to a greater extent than any other insecticide.

Committee of Inquiry into Fowl Pest

All those who wish to submit evidence to the Committee of Inquiry into Fowl Pest appointed by the Ministry of Agriculture, Fisheries and Food and the Secretary of State for Scotland should send a memorandum expressing their views to the Secretary of the Committee—Mr. R. A. Isaacson, Great Westminster House, Horseferry Road, London, S.W.1.

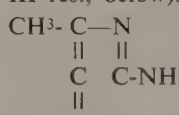
The Committee's terms of reference are:—

"To review the policy and arrangements for dealing with fowl pest in Great Britain, and to advise whether any changes should be made in the light of the growth of the poultry industry, present scientific knowledge and technical and administrative experience gained in recent years in this and other countries."

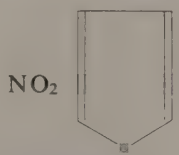
Drugs used for treatment of animal coccidiosis

from a Special Correspondent

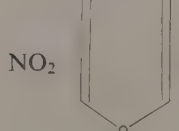
Animal coccidiosis is sometimes treated with a Sulpha drug, sulphamezathine (2-(-aminobenzene sulphonamido)-4:6-dimethyl pyrimidine, (I below) and sometimes with nitrofuran and/or furazolidone (II and III res., below).



I Sulphamezathine
2 (p-*aminobenzene sulphonamido*)-4,6-*dimethyl pyrimidine*



II Nitrofuran
a—*nitrofurfuraldehyde semicarbazone*



III Furazolidone
3-(5-*nitrofuroylideneamino*)-2-*oxazolidone*

The actual drugs are mixed with vegetable material such as oat or wheat husk for purposes of oral administration; in some cases, when the furan derivatives are used, a falling off of strength of drug content on storage has been noted in our laboratories.

It has been found that the cause of this is reduction of nitrofuran and of furazolidone to the corresponding amino compounds, due to the presence in the vegetable diluent of reducing materials such as tocopheol, when wheat germ oil have been incorporated into the formulation of ascorbic acid from other vegetable source.

There should be little trouble in this respect from the use of good quality oat or wheat husk and 'economics' in formulation at the expense of good quality, analytically checked, can lead to the opposite effect. The use of cheap vegetable residues, unchecked for presence of reducing materials, in nitrofuran formulations is to be depreciated; use of checked high quality diluent should give sufficiently stable products. If additional nitrofuran or furazolidone is incorporated into the composition to counter any possible reductive losses, attention should be paid to possible consequent increase in toxicity.

The Beckman method of determination of the furan content of nitrofuran, furazolidone or mixtures of these furan derivatives in animal drug mixtures has not proved to be satisfactory and special methods of analysis have to be employed.

Technical Information Centre. Change Address.

The African Pyrethrum Technical Information Centre Ltd., formerly at 4, Grafton Street, London, W.1. changed their address on September 1st, 1960 to:—

Rooms 215-217,
Grand Buildings,
Trafalgar Square,
London, W.C.2.
Telephone No.: TRAfalgar 4288.

Gallwey Pest Control Limited Move London Offices.

Gallwey Pest Control Limited, the timber pest consultants, announce that they have moved their London offices from 356/8 Evelyn Street, S.E.

8., to 16/17 Devonshire Square, E.C. 2. Mr. D. K. M. Gilbert, D.S.C., a Director of Gallwey Pest Control Limited, said recently:-

"Our decision to change our London offices has been largely governed by our overall expansion plants. We are enlarging our laboratories at Marlow at the same time in order to give our clients a better service.

At Marlow our sister Company, Sir John Gallwey Instruments Ltd. has also now increased its capacity for the production of the protimeter, the pocket-size moisture meter for wood, concrete, plaster and other building materials. This meter is now being exported to many countries of the world, particularly in the Commonwealth".

A.B.M.A.C. Conference – Preliminary Notice.

An Insecticide and Fungicide Conference, organised by the Association of British Manufacturers of Agricultural Chemicals, will be held at Brighton, from 6th November—10th November, 1961.

Further announcements relating to the Conference will be made in due course.

B.W.P.A. Annual Convention 1961

The 1961 Annual Convention of the British Wood Preserving Association will be held at Cambridge University from Tuesday 11th to Friday 14th July, 1961.

Information about accommodation and papers to be presented will be circulated to members early in 1961.

New Pyrethrum Sales Appointment in Europe.

The Pyrethrum Board of Kenya has announced the appointment of Mr. Anthon Bakker as its sales representative in Belgium, Denmark and Holland.

Mr. Bakker will be directly responsible to the Board but will operate from Brussels. Mr. R. H. McLellan will remain the European technical sales representative of African Pyrethrum Technical Information Centre Limited.

New Farm Director for High Mowthorpe Experimental Husbandry Farm

Mr. R. W. Shepherd, M.A., Dip. Agric. (Cantab.), has been appointed Farm Director at High Mowthorpe Experimental Husbandry Farm, Duggleby, Malton, Yorks. He will succeed Mr. R. E. MacKenzie, the present Farm Director, who has resigned.

Mr. Shepherd is at present a General Agriculture Advisory Officer in the National Agricultural Advisory Service at Bridgets Experimental Husbandry Farm, Martyr Worthy, Winchester, Hants. He will take up his duties at High Mowthorpe on 1st September.

New Farm Director for Terrington and Kirton Experimental Husbandry Farms.

Mr. F. E. Shotton, M.A. (Hons.), Dip. Agric. (Cantab.), has been appointed Director of Terrington and Kirton Experimental Husbandry Farms, Terrington St., Clement, King's Lynn, Norfolk. He will succeed Mr. A. C. Owers, M.A., Dip. Agric., who is resigning, on 1st November.

Mr. Shotton is at present Deputy County Advisory Officer, Norfolk, in the National Agricultural Advisory Service.

Mr. D. J. S. Hartt, President of the I.P.C.A. (pictured on the right) with other guests at the luncheon given to mark the 60th anniversary of Thos. Harley, Ltd.

The Piper Calls the Tune.

Many have sung the praises of the fair maid of Perth but its a fair bet that more have quietly blessed the Piper O' Perth. Why? Because the piper is the trade mark of Thos. Harley Ltd. whose Rodine rat poisons have become universally known.

This year the firm celebrated their diamond jubilee and they can look back on a successful history that reads almost like a fairytale. Sixty years ago a young pharmacist, Thomas Harley, bought a small shop in Perth. Like many chemists in those days he concocted many of his own preparations one of which was phosphorous rat poison.

Started more or less as a side line his preparation, which he called Rodine, rapidly attained fame throughout the town and, indeed, for miles around. Such was the demand for this preparation that after a few years its manufacture and sale became the most important part of the business.

By 1910, the business had to be re-organised in order to cope with the increasing demands for Harley's rat poison. Orders from all parts of Great Britain poured in and led to the establishment of a wholesale business. A new four storey factory was erected, which, it was considered, would fully meet the manufacturing requirements of Rodine. However the snowball became an avalanche, in a short time the factory was found to be unequal to the task and in 1928 an even larger factory with four extensive floors was acquired, which is the present headquarters of the business. The building is equipped with the latest in machinery to meet the requirements in production.

After the death of Mr. Harley in 1932 the business was converted into a limited company with Sir Francis Norie-Miller, Baronet as chairman of the Board of Directors and Mr. Angus F. McIntosh, who had joined the firm in 1910 as manager, becoming Managing Director.

Round about this time a red squill preparation was placed on the market, as a companion line to the original phosphorous compound, to meet the demand for a rat poison that could safely be used in the home and in places where domestic animals and pets have access.

The considerable export trade which had been built up from 1933-1939 was severely curtailed during the war when almost the entire efforts of the company's trading were channelled into the Home market. Following the war the threads were quickly picked up again and fresh contacts made. Now the company's Rodine preparations are sold in 47 different countries throughout the world.

Another post war development was the addition of the anti-coagulants to the Rodine family of rodenticides in 1953. Not only does the company manufacture proprietary preparations of warfarin, but also the pure chemical which conforms to the specification of W.H.O. and the Infestation Control Division of the M.A.F.F.

Despite his sixty years the Piper O' Perth continues to lead rats and mice in their merry dance of death.

NEWS

New Company, New Literature, New Product.

The newly formed Preservation Developments Company Ltd., who handle the wood preserving interests of the Standardised Disinfectants Company their parent company, recently announced an addition to their Brunophen family of preservatives. The new formulation–known as Brunophen R60 is a woodworm killer with the unusual property of having a mild but positively pleasant odour. Like the other members of the family Brunophen R 60 is an organic solvent type preservative classified as type OS 3 in BS 1282: 1959. It contains the active ingredients pentacholorphenol and dieldrin for action against a wide range of fungi and insects.

Further information concerning these wood preservatives is to be found in Preservation Development's new Technical Leaflet, "Brunophen" one of two leaflets issued to mark the formation of this new company. The second leaflet is entitled "Specification for Eradication of Woodworm and Dry Rot" and is intended to assist Architects, Surveyors, Estate Agents and others liable to encounter timber pest problems. The specification provides directions for eradication of woodworm dry rot and other pests of timber, using Brunophen products.

Record Sum for Colonial Development in 1959/60 - Includes Pesticides Research.

Britain provided the record sum of £25½m for development and welfare schemes to benefit her overseas territories, in the last financial year.

This is shown by provisional figures in the annual Return of Schemes made under the Colonial Development and Welfare Act by the Secretary of State for the Colonies (Mr. Iain Macleod). The return, covering the period April 1, 1959 to March 31, 1960, was published on Thursday, August 25, 1960 as House of Commons Paper No. 244 by Her Majesty's Stationery Office, price 2/6d. Commitments undertaken during the year totalled £33,001,222 for development projects and £2,370,261 for research.

In the economic field, the total of grants approved during the year amounted to £3,713,340. Agricultural and veterinary schemes headed the list, accounting for £1,990,603; other outstanding totals in this sector were the £355,635 granted for forestry schemes, £331,126 for soil-conservation projects and £323,418 for irrigation and drainage.

Grants approved for research work totalled £2,370,261. This total included £1,009,974 for agricultural research, £560,600 for work on pesticides and £375,080 for medical research.

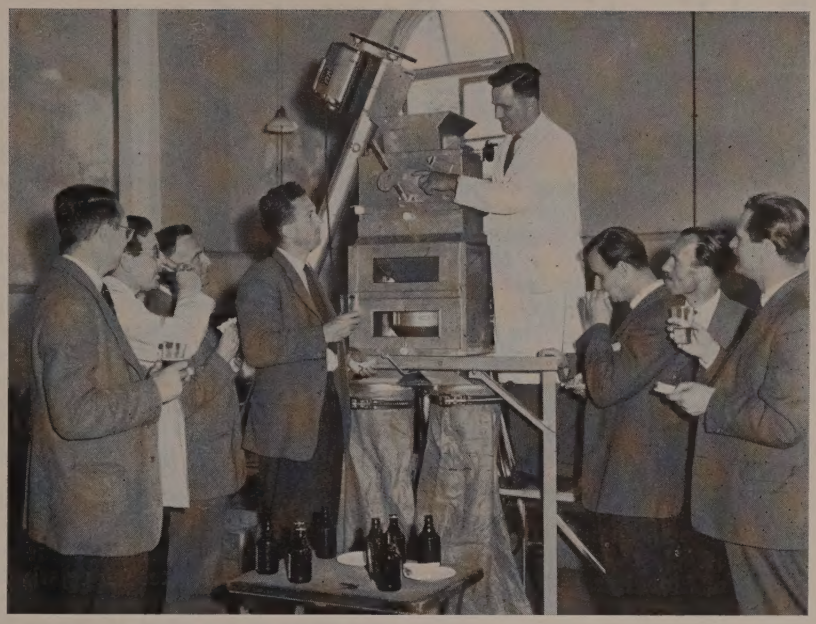
Annual Report of the Tropical Products Institute.

The D.S.I.R. announce that during the next five years, research priority at the Tropical Products Institute will continue to be given to immediate industrial problems and projects promising application within a fairly short period. The Institute will also be looking to the future development of industries in tropical countries, and undertaking some research of a longer-term nature.

These are the main features of the new five-year programme which is given in detail in the first annual report of the Institute since it became part of the Department of Scientific and Industrial Research in April 1959. The main aim of the Institute is to improve the economic well-being of under-developed tropical territories, especially those within the Commonwealth. The wide range of research undertaken is described in the report.

Our readers may already be aware of the fact that the Institute devotes a substantial effort to insecticides, and important research concerns the determination of residues of insecticides on various tropical products, examination of insecticidal powders, and collaborative work on insecticide analysis.

Recent work includes malathion in groundnuts (for Nigeria), D.D.T. in green and fired tea (Ceylon) and pyrethrins and piperonyl butoxide in cocoa. It has been done in collaboration with the World Health Organisation's Expert Committee on Insecticides. In addition, samples of insecticide formulations have been examined and technical information provided on the revision of pesticide specifications.



The safety of the Mist-O-Matic method allows refreshment to be taken whilst seed treatment is in progress. This is not recommended in practice. There is no need to attend a Celtic v. Rangers match to appreciate the obvious danger of empty beer bottles.

Safe Liquid Seed Dressing

British Schering Ltd., have recently held a series of demonsrtations in various parts of Great Britain to show to feed merchants, farmers, the press and others, their Mist-O-Matic method of seed treatment (See *Pest Technology*, **2** (5) pp 94-97) which, it is claimed, is the safest and most efficient method of applying seed dressings.

In support of this claim it is stated that the traditional method of applying mercurial seed dressings in the form of a dry powder presents a serious hazard to operators in the form of a fine dust which blows about and pollutes the atmosphere both during the process and afterwards. In view of this danger operators must wear protective clothing and establishments in which powder dressings are used must, by law, be fitted with special fume extractors. Despite these precautions the danger of mercury poisoning persists.

In an effort to overcome the short-comings of the powder method liquid dressings have been turned to. The biggest problem with liquid dressings is to obtain even distribution over the surface of each seed of small amounts of liquid. One way of overcoming this difficulty is to use volatile mercury compounds which diffuse throughout the seed mass. The use of these compounds represents an advance on dry seed dressings in terms of efficiency and safety. Unfortunately the volatile compounds used (alkyl mercury compounds) are among the most poisonous mercury compounds available and the risk of mercury poisoning from the mercury vapours, that arise during seed dressing, handling and storage, remains.

The Mist-O-Matic method removes this hazard for the unique action of the machine, in which uniform distribution is obtained at the time of application, allows phenyl mercury liquid dressings to be used. These compounds are non volatile and are relatively harmless when compared with the volatile methyl mercury liquid dressings. The amount of atmospheric pollution (with toxic mercury vapour) that occurs when these non-volatile seed dressings are used is so slight that the Ministry of Agriculture, Fisheries and Food have agreed that they can be used without fitting any additional air extractor system on the premises where seed treatment is carried out. The Mist-O-Matic is the only seed dressing method which can be used without fitting special fume extractors, or using special clothing.

Publications Received

Agricultural Insects of East Africa *Compiled by R.H. le Pelly. Published by East Africa High Commission, Nairobi, Kenya. Price* £2 - 2.

Apart from a one page introduction and two pages of directions on how to use it, the 305 pages of this book consists of a list of East African plant feeding insects and mites, with their host plants, their parasites and predators. The distribution of the insects by territories is given as is references to the literature together with lists of stored products insects and introduced insects mainly covering the period 1908 to 1956.

The list is divided into 11 sections including:- Mites with their Host Plants, Insects with their Host Plants, Index of Host Plants Parasites, Predators, Stored product insects. A comprehensive index allows adequate cross references.

One cannot help but admire the industry of those--particularly R. H. le Pelly and his typist--who were concerned with the list compilation of this list. This reference book will be an invaluable aid to entomologists working in East Africa.

"Advances in Pest Control, Vol. III" *Edited R. L. Metcalf, published, Interscience Publishers,* 250, *Fifth Ave., New York* 1 *and* 88/90 *Chancery Lane, London, W.C.*2., 1960 *Price* 109/-.

The third volume of "Advances in Pest Control" maintains the high standard of the previous volumes in this series and is indispensable reading for anybody interested in the scientific basis of control of insects, weeds, fungi and other pests.

Of the nine papers in this volume, four deal specifically with insect control. R. C. Bushland writes about control of screw-worms, *Callitroga hominivorax*, by releasing sterilized male flies in infested areas and discusses the application of this technique of biological control to other species of pests. P. S. Hewlett of the Pest Infestation Laboratory, Slough, reviews the state of knowledge of mixtures of insecticides with other insecticides or with non-insecticidal synergists in a critical and thoughtful review. Green, Berbza and Hall summarise the information on chemical attractants for insects. Lipke and Kearns have performed the same arduous task on the subject of DDT dehydrochlorinase.

On fungicides, weedkillers and nematocides there are papers on the dithiocarbamate fungicides, triazine derivative herbicides and organic halide nematicides, all of which provide basic information on the chemistry, biology and mode of action of these important groups of pesticides. They implicitly emphasise the importance of a sound fundamental knowledge of these topics for all concerned with formulation or advisory work in the field of pest control.

Finally, there are two papers of the widest interest. One by F.P.W. Winteringham discusses the radio-isotope labelled pool technique, which he has done so much to pioneer, for studying the effect of chemicals on plants and insects. The other by J. W. Mitchell, B. C. Smale and R. L. Metcalf deals with the many factors of plant anatomy and cytology affecting the absorption and translocation of pesticides and antibiotics possing systemic properties. It will be a valuable aid to rational development and utilisation of systemic pesticides.

"Methods of Testing Chemicals on Insects", Vol. II, *edited H. H. Shephard, published Burgess Publishing Co.,* 426 *So. 6th St., Minneapolis* Price $5.

Again this book is one of a series and purports to cover the field of screening chemicals as insecticides, acaricides, repellents and attractants and the effect of such factors as pre-test breeding conditions and post test holding conditions on experimental results. The contributions are uneven in quality but generally follow the pattern of 'X' and 'Y' (1954) did this and 'Z' *et al* (1960) did that. The result on the whole is unsatisfactory, superficial and remote from the very real difficulties and complications of testing insecticides. For example, testing of livestock dips, sprays, dusts and dressings is dealt with in six and a half pages while termite repellents are dealt with in a single page!

The title of the series strikes the reviewer as having a somewhat odd ring. Perhaps we can look forward to a companion series on mammalian toxicity tests entitled "Methods of trying it on the Dog".

Report of the Government Chemist 1958-1959.

Published by H.M.S.O. for D.S.I.R. Price 3/6*d.*

The Report refers to the reorganization of the Laboratory into five divisions of which one carries out special research and controls the more involved physical methods of examination. The others deal with a wide range of analytical, investigatory and advisory problems including those affecting national revenue, foods, water, drugs, agricultural chemicals and a variety of other materials.

It is the work on agricultural chemicals that will be of especial interest to our readers. This work includes a note on a specific investigation made into the relative merits of two chromatographic methods for separating 2,4-D and 2,4,5-T. In this connection it is further stated that mixtures of these and other chlorophenoxy acids of the same series are finding increasing use in agriculture but no general solution to the problem of the analysis of such mixtures is yet available.

Work that has been and is being carried out, such as partition chromatographic methods of determining MCPA and dinoseb, is also mentioned. The report also deals briefly with work carried out on the determination of insecticide residues in plant tissues, by means of the technique of cholinesterase inhibition as suggested by Michel.

Reference is made to the development of a method of analysis with the object of checking the identity of the organo-mercury compounds present in formulations of water soluble mercurial seed dressings.

The work done in the Government Laboratory, includes research on methods for determination of residues and co-operation in obtaining residue data to assist in the framing of recommendations regarding the use of pesticides in which the determination of residues of DDT, BHC, chlorbenside, chlordane toxaphene, methoxychlor, aldrin, endrin, dieldrin, fluoroacetamide, demeton methyl, Phosdrin, Thimet, malathion and mercury pesticides, is briefly mentioned.